The evolution of my HF kayak antennas

Maritime mobile from the waterways of northern California!
Comparing my various antennas to one standard antenna.

Bil Paul KD6JUI

But first, early bicycle ops

While living in Bay Area, operated 2 meter mobile while bicycle commuting to work – using a J-pole antenna.

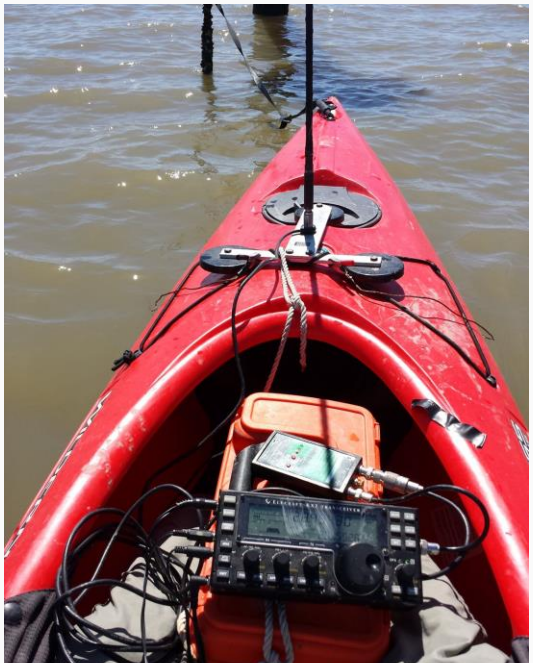
While on annual bicycle tours operated HF using, variously, G5RV, inverted V, ground plane, and end-fed half-wave wire vertical.

Taking up kayaking

Moved to Dixon (between Vacaville and Davis) in 2009 and took up kayaking with a friend. Explored waterways ranging from Petaluma River on the west to Folsom Lake on the east, plus Lakes Berryessa, Solano and Washington and all the sloughs in the delta.

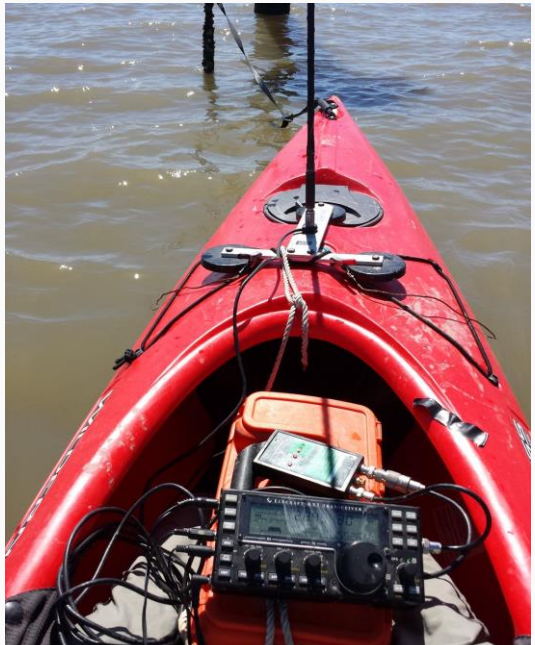
First kayak antenna – getting started as easily as possible in 2015

Using a hamstick rig I had on hand, meant for vehicle use, I secured the 20 meter version to the front of the kayak using bungee cords. I added one wire radial floating on the brackish water (length not recorded). Used Elecraft T-1 autotuner for best SWR. Had very few contacts.



Advantages and disadvantages of the hamstick antenna

- Had it on hand
- Easy to set up, easy to transport
- Light weight
- Probably only good for one band
- Not very secure on kayak
- Requires radial/radials
- Didn’t result in many contacts



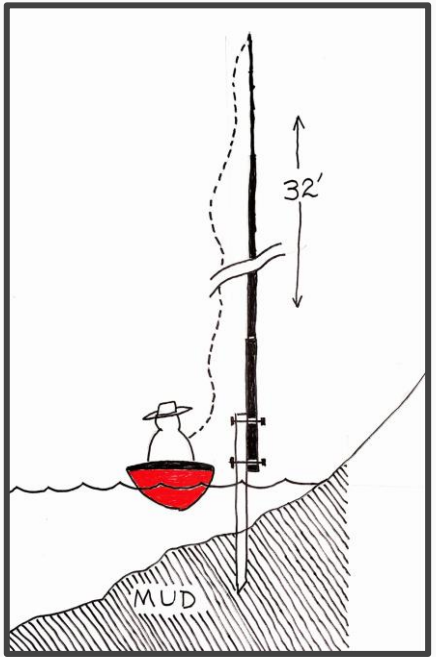
Performance of hamstick antenna recently (with half-wave 30’ radial on water surface and autotuner) compared to reference antenna (end-fed half-wave wire vertical antenna cut for 20 meters). Performance compared in receive mode, using 15 MHz WWV signal from Boulder, CO. Test conducted on Lake Solano (fresh water). Some QSB. WWV on 20 MHz not strong enough to use for testing.

- Hamstick S9 to 5dB over S9
- **End-fed half wave** **5 to 10 dB over S9**

Surprising result !!

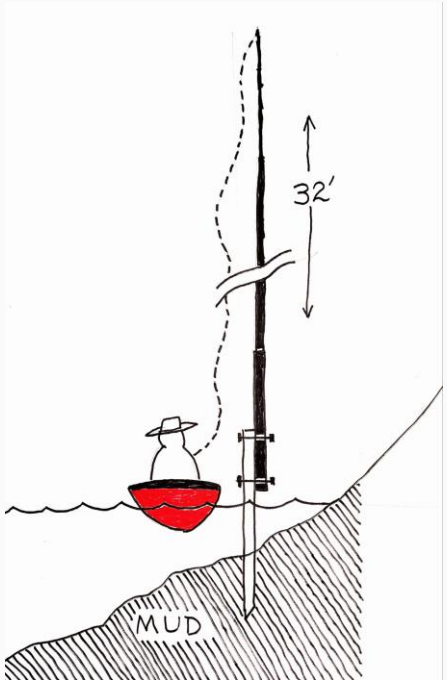
Second kayak antenna – served as reference antenna – an end-fed half-wave wire vertical cut for 20 meters

This is an off-the kayak antenna using a 32-foot MFJ fiberglass telescoping pole holding up a half wave of wire cut for 20 meters, but also loadable on 30 and 17 meters. I sink a PVC pipe into mud or sand alongside the kayak, and bolt the MFJ pole to it. If I can’t sink the pipe into the waterway bottom I can attach the MFJ pole to a fixed object along the waterway. I use a manual, home-brew antenna tuner.



Second kayak antenna – an end-fed half-wave wire vertical cut for 20 meters: Advantages and disadvantages

- Easy to transport
- Attains good height
- Doesn't require a radial or radials
- Takes a long time to set up and take down
- Requires good below-water mud or sand
- Have to tape up MFJ-pole joints to prevent collapsing joints
- Can be heavy and awkward to bolt pole to pipe and position it
- Can lean over due to wind or insufficient mud or sand to anchor the pipe
- Can be difficult to pull pipe out of mud!

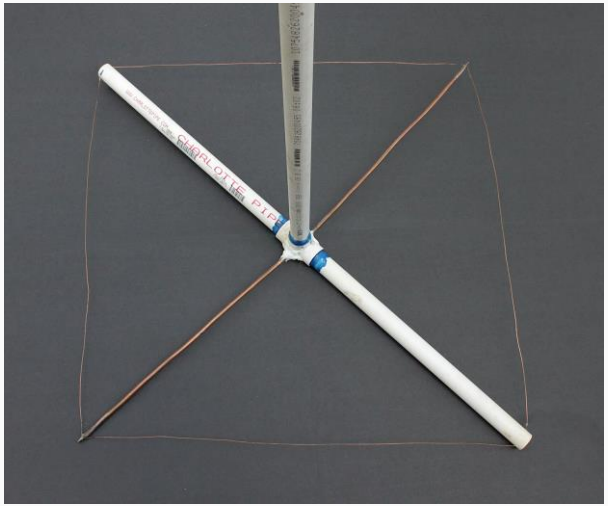


Performance of end-fed half-wave wire vertical on different days. Receive test using WWV signal from Boulder, Co. Test conducted on Lake Solano (fresh water). Some QSB.

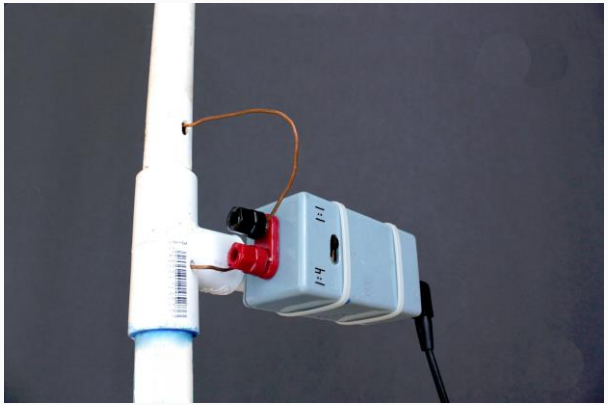
- 10 MHz: ranging from S6 to S9
- 15 MHz: ranging from 3 dB over S9 – to – 20 dB over S9

Third kayak antenna – resulting in a QST article – an off-center-fed vertical dipole with capacitance hats

I liked the idea of a vertical dipole. I kept its height at 9 feet so as to not destabilize the kayak. It uses an Elecraft balun. It's loadable from 40 meters through 6 meters. Its natural resonance is just above the 15-meter band. I choose to use an off-center feed point mostly to make the coax run as short as possible. People who see it often think it's a sail. My article about it is in the November 2016 QST. All the pipes contain wires. The capacitance hat on top is square in shape.



At right: Antenna could be separated at this coupling joint. Balun switchable between 1:1 and 1:4.



Third kayak antenna – off-center-fed vertical dipole with capacitance hats – advantages and disadvantages

- Loads on all bands 40 meters thru 6 meters
- Came apart to fit in Prius
- Fairly lightweight
- Doesn’t destabilize the kayak
- PVC pipes protect inner wires from water
- Doesn’t require radials
- Catches the wind a little, but not a sail!
- Stress on the separation joint caused it to crack – had to glue it closed – so antenna no longer fit inside Prius

Performance of vertical dipole compared to reference antenna (end-fed half-wave wire vertical antenna cut for 20 meters). Performance compared in receive mode, using WWV signal from Boulder, CO.

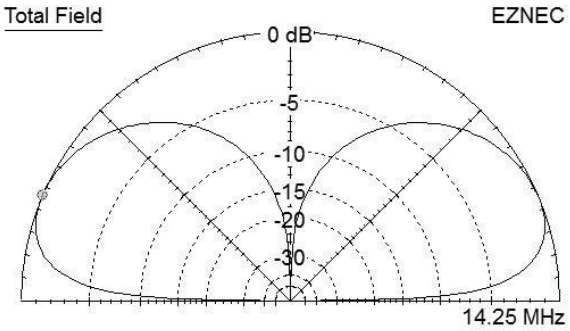
10 MHz

- Vertical dipole S3-S5
- **End-fed half wave** **S7-S9** **(Quite a difference)**

15 MHz

- Vertical dipole 5 to 10 dB over S9
- **End-fed half wave** **20 dB over S9**

EZNEC elevation profile for OCF vertical dipole/14 MHz



Elevation Plot
Azimuth Angle 0.0 deg.
Outer Ring 1.04 dBi

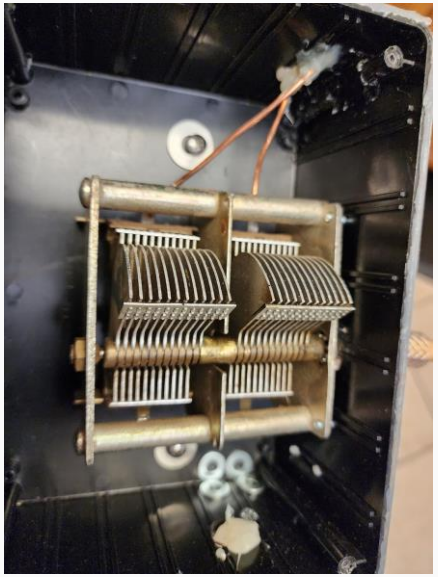
Slice Max Gain 1.04 dBi @ Elev Angle = 157.0 deg.
Beamwidth 45.4 deg.; -3dB @ 128.2, 173.6 deg.
Sidelobe Gain 1.02 dBi @ Elev Angle = 23.0 deg.
Front/Sidelobe 0.02 dB

Fourth kayak antenna – first loop antenna – quick and easy – MFJ pocket loop antenna

Eager to try a loop antenna on the kayak, I bought a used MFJ pocket loop antenna (MFJ had been sold out). It has two variable capacitors and two posts to connect to a loop of thick copper wire. I learned why the ham sold it – I kept having problems with one of the varicaps and gave up on it after only one contact. Anyway, it got me on the road to using loops. No comparison tests were done.

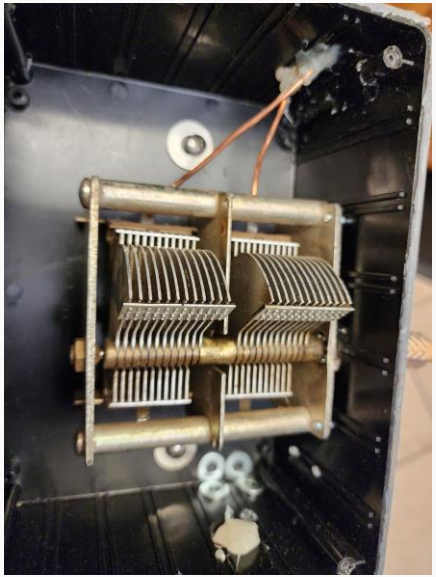
Fifth kayak antenna – a parts-box loop antenna using copper pipe

Moving on, I concocted a modest loop antenna about a yard in diameter using three-eighths inch (outer diameter) copper pipe and a parts-box, double-ganged variable capacitor which could be wired to eliminate a wiper contact. This loop and all my following loops used the popular “loop-within-the loop” matching system.



Fifth kayak antenna – a parts-box loop antenna using copper pipe – advantages and disadvantages

- Lightweight and fits easily in car
- Doesn’t need separate tuner
- Directional in direction of loop plane, but have to rotate kayak to change direction of max signal
- Doesn’t need radial or radials
- Loads 30 meters through 10 meters
- Very sharp tuning; no reduction gear on varicap
- Varicap had many mechanical connections between rotor blades, but avoided using wiper contact



Performance of fifth kayak antenna (first homebrew loop) compared to reference antenna (end-fed half-wave wire vertical antenna cut for 20 meters). Performance compared in receive mode, using WWV signal from Boulder, CO.

10 MHz

- Small loop S2-S3
- **End-fed half wave** **S6** **(Quite a difference)**

15 MHz

- Small loop S8 to 2 dB over S9
- **End-fed half wave** **3 to 7 dB over S9**

Sixth kayak antenna – my best-performing loop

I built an improved 44-inch diameter loop antenna using 1-inch-outer-diameter copper pipe I had on hand and an MFJ butterfly variable capacitor (18-136 pf) with aluminum-welded stator blades (done by a metal fabrication shop) for better conductivity. Bending the pipe was a major chore. On the other hand, the stiffness of the pipe makes the loop more self supporting.

Sixth kayak antenna – my best-performing loop – advantages and disadvantages

- Directional
- 6:1 reduction drive makes tuning easier
- No purely mechanical connections except for coax connection to transceiver
- Could handle higher power
- Heavier
- Only tunable on 30, 20 and 17 meter bands due to varicap limitations
- Barely fits into Prius hatchback
- Varicap access not easy

Welded va
stator blad

Performance of sixth kayak antenna (second, larger homebrew loop) compared to reference antenna (end-fed half-wave wire vertical antenna cut for 20 meters). Performance compared in receive mode, using WWV signal from Boulder, CO.

10 MHz

- Larger loop S7-S8
- **End-fed half wave** **S7-S9**

15 MHz

- **Larger loop** **15-20 dB over S9**
  Surprise!
- End-fed half wave 10-15 dB over S9

Seventh kayak antenna – a simple but unique design using a single copper strip

A work in progress. The use of one 10-foot-long, 4-inch-wide copper strip as both the loop and the variable capacitor make it unique + it's motorized. I figured the oblong loop (37" by 27") would do well on 15 meters through 10 meters when those bands were open. However, in a receive test with Tony, KQ2I, we found a distributed capacitance problem due to the wide strip. So I reduced the width of most of the strip to two inches.

Left: The loop being built. Top black circle shows the ends of the copper strip with a worm gear varying the distance between them to change capacitance. Bottom circle is the 20 rpm motor. Some mods were made later.

Seventh kayak antenna – advantages and disadvantages

- Motorized; uses outboard transceiver battery to power motor
- Copper strip acts as both loop and variable capacitor
- Wide range of capacitance
- Tunes between 17m and 10m
- Small loop/wide copper strip presented distributed capacitance problems
- Poor efficiency below 15 meters
- Teflon cutting boards used in construction will bend over time

Performance of seventh kayak antenna (small copper strip loop) compared to reference antenna (end-fed half-wave wire vertical antenna cut for 20 meters). Performance compared in receive mode, using WWV signal from Boulder, CO.

15 MHz

- Small copper strip loop 5 to 10 dB over S9 Surprise!
- End-fed half wave 5 to 10 dB over S9

Is the distributed capacitance problem gone from the small copper strip loop? If it is, the loop should show reduced signal strength when the plane of the loop is 90 degrees away from the direction of the signal source.

In this case, the reference antenna was my largest loop antenna which uses a pipe. In a listening test using WWV at 15 MHz, there was a about a 12 dB difference between pointed toward WWV and 90 degrees away.

Using the small copper-strip antenna, the difference was only about 5 dB. So apparently there still is a distributed capacitance problem.

However, on Oct. 3, 10 meters was open and I had my first contacts with this antenna, getting 3 SSB QSOs on the east coast. Then I checked out 15 meters and had an SSB QSO with JG1OUT. All while running 5 watts output.

Does a loop antenna perform better over fresh water than over land?

Also, on Oct. 3 I performed receiving tests over land and over fresh water using my largest loop antenna and the copper strip loop antenna. The distance between the loops and soil and between the loops and fresh water was about the same (about a yard).

The performance over both was the same. Somehow I'd been fooling myself that performance over water (even if not saltwater) would be better.

If antenna reciprocity holds true with the loops, transmitting results should be the same.

Results should be better when kayak antennas are used over ocean saltwater …..

Small HF loop antennas have their “sweet spots.” Below are radiation efficiencies of small HF loop antennas of various diameters when using 1” or three-fourth-inch copper pipe and no resistance losses, I assume (*from 66pacific.com antenna calculator*).

6 feet diameter: 28MHz - 99%, 21 MHz - 98%, 14 MHz - 94%, 7 MHz - 58%

3 feet diameter: 28 MHz - 96%, 21 MHz - 89%, 14 MHz - 66%, 7 MHz - 15%

1.6 feet diameter: 28 MHz - 74%, 21 MHz - 51%. 14 MHz - 20%, 7 MHz - 2%

(The 3-foot diameter loop is the approximate size of my largest loop antenna)

Radiation exposure from kayak loop antennas when running 5 or 10 watts power.

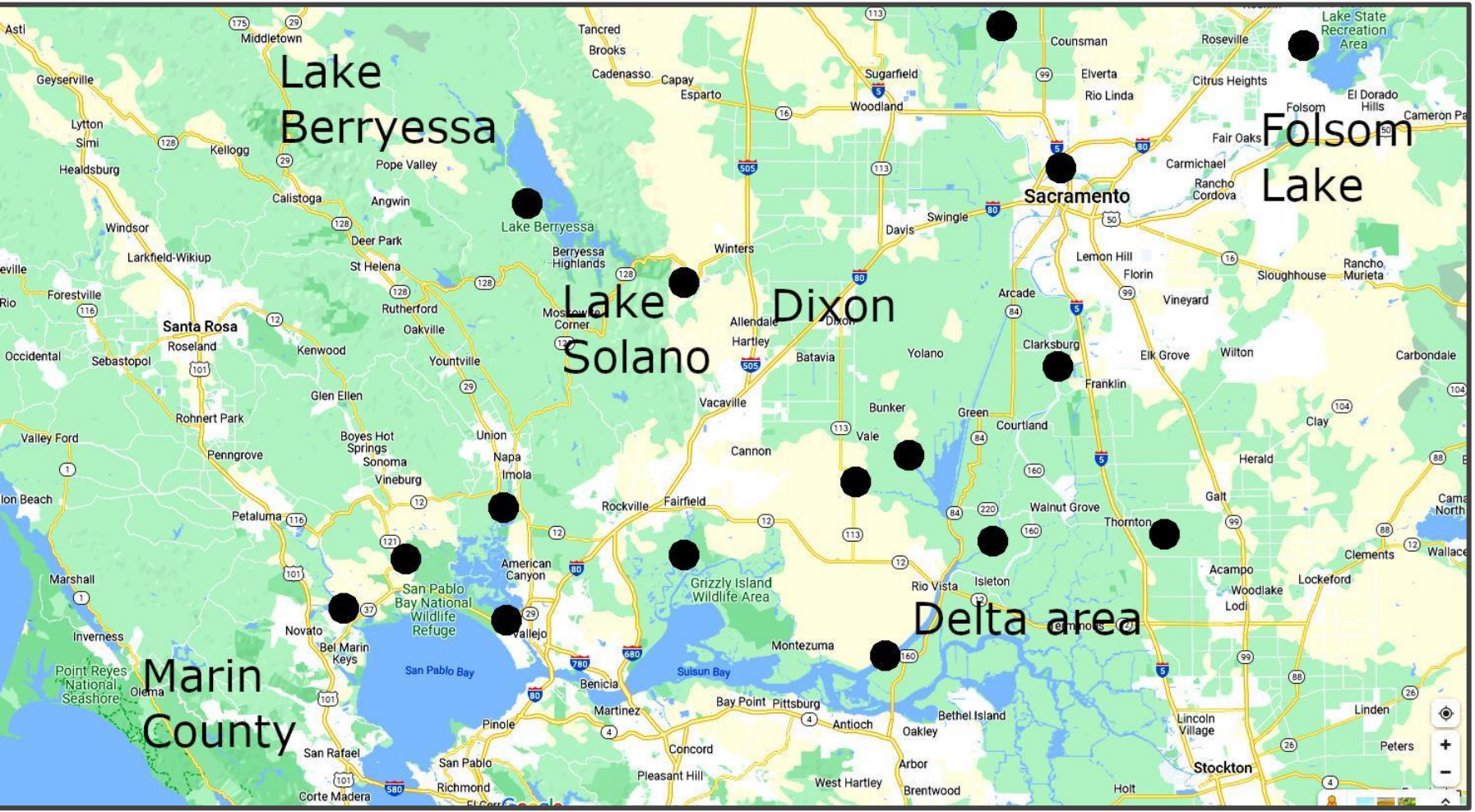
A quick look online indicates that one should be at least 4 feet from a loop running 5 watts and about 5 feet while running 10 watts.

In my kayak, my upper body is 4 feet from the loop, although the ends of my legs extend to nearly below the loop and are about 2 and ½ feet from the bottom of the loop. Perhaps I should put some shielding over my legs!

My kayaking buddy Jeff Brook (the fisherman on right) and I beginning a three-day trip down the Sacramento River last July. I'm carrying part of my telescoping end-fed half-wave antenna pole on the side of the kayak.

I carried my Elecraft KX3 xceiver, with a 5 amp-hour NiMH outboard battery and lithium AA internal batteries. We use FRS walkie talkies to communicate with each other.

Some of the areas we've kayaked in northern California.



A small plug for a book I authored which will be available Nov. 28: *Awaiting the Sun: WWII Veterans Remember the Aleutians.*

Published by Schiffer Military. If you look carefully you'll find several references to ham radio in it.